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Quantifying Impairments in Whiplash-Associated Disorders and Association with Patient-Reported Outcomes

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Abstract : Introduction: Whiplash-Associated Disorder (WAD) is a health problem characterized by motor, neurological and psychosocial symptoms, stressing the need for a multimodal treatment approach. To achieve individualized multimodal approach, prognostic factors need to be identified early using validated patient-reported and objective outcome measures. The aim of this study is to demonstrate the degree of association between patient-reported and clinical outcome measures of WAD patients in the subacute phase. Methods: Individuals (n=41) with subacute (≥1, ≤3 months) WAD (I-II), medium to high-risk symptoms, or neck pain rating ≥ 4/10 on the Visual Analog Scale (VAS) were examined. Outcome measures included measurements for movement control (Butterfly test) and cervical active range of motion (cAROM) using the NeckSmart system, a computer system using an inertial measurement unit (IMU) that connects to a computer. The IMU sensor is placed on the participant's head, who receives visual feedback about the movement of the head. Patient-reported neck disability, pain intensity, general health, self-perceived handicap, central sensitization, and difficulties due to dizziness were measured using questionnaires. Excel and R statistical software were used for statistical analyses. Results: Forty-one participants, 15 males (37%), 26 females (63%), mean (SD) age 36.8 (±12.7), underwent data collection. Mean amplitude accuracy (AA) (SD) in the Butterfly test for easy, medium, and difficult paths were 2.4mm (0.9), 4.4mm (1.8), and 6.8mm (2.7), respectively. Mean cAROM (SD) for flexion, extension, left-, and right rotation were 46.3° (18.5), 48.8° (17.8), 58.2° (14.3), and 58.9° (15.0), respectively. Mean scores on the Neck Disability Index (NDI), VAS, Dizziness Handicap Inventory (DHI), Central Sensitization Inventory (CSI), and 36-Item Short Form Survey RAND version (RAND) were 43% (17.4), 7 (1.7), 37 (25.4), 51 (17.5), and 39.2 (17.7) respectively. Females showed significantly greater deviation for AA compared to males for easy and medium Butterfly paths ($p<0.05$). Statistically significant moderate to strong positive correlation was found between the DHI and easy ($r=0.6$, $p=0.05$), medium ($r=0.5$, $p=0.05$)) and difficult ($r=0.5$, $p<0.05$) Butterfly paths, between the total RAND score and all cAROMs (r between 0.4-0.7, $p\leq0.05$) except flexion ($r=0.4$, $p=0.7$), and between the NDI score and CSI ($r=0.7$, $p<0.01$), VAS ($r=0.5$, $p<0.01$), and DHI ($r=0.7$, $p<0.01$) scores respectively. Discussion: All patient-reported and objective measures were found to be outside the reference range. Results suggest females have worse movement control in the neck in the subacute WAD phase. However, no statistical difference based on gender was found in patient-reported measures. Suggesting females might have worse movement control than males in general in this phase. The correlation found between DHI and the Butterfly test can be explained because the DHI measures proprioceptive symptoms like dizziness and eye movement disorders that can affect the outcome of movement control tests. A correlation was found between the total RAND score and cAROM, suggesting that a reduced range of motion affects the quality of life. Significance: The NeckSmart system can detect abnormalities in cAROM, fine movement control, and kinesthesia of the neck. Results suggest females have worse movement control than males. Results show a moderate to a high correlation between several patient-reported and objective measurements.

Keywords : whiplash associated disorders, car-collision, neck, trauma, subacute
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